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POLYPODIUM VIRGINIANUM AND P. VULGARE

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IN eastern America we are so used to designating our common Polypody of rocky woods as *Polypodium vulgare* L. and the hosts of fern-specialists who have studied our ferns during the last three-fourths of a century have so universally followed this usage, that to many people it may seem as if our fern has a vested right to the name. When, however, we look into the original treatment of Linnaeus in the *Species Plantarum*,<sup>1</sup> it is at once clear that he restricted the name *P. vulgare* exclusively to the plant of Europe (“*Habitat in Europa rimis rupium*”); while to the plant of eastern America (“*Habitat in Virginia*”) he assigned the name *P. virginianum*. Linnaeus also included under *P. virginianum* a citation of one of Plumier’s West Indian plates and a reference to Petiver which do not belong with the Virginian plant, but the source of his name was clearly the *Polypodium virginianense minus, foliis obtusioribus* of Morison’s *Plant Hist. Univ. Oxon.* iii. 563, sect. 14, t. 2, fig. 3 (1715), published with a good illustration and very fair description of the common Polypody of eastern America. Morison’s conventionalized figure showed the rootstock unusually clean of scales (although occasional herbarium-specimens of the American plant have almost

<sup>1</sup> L. Sp. Pl. ii. 1085 (1753).

completely lost them) and from this fact Linnaeus was misled into over-emphasizing this rather unusual and post-mortem character, describing his *P. virginianum*: "Polypodium frondibus pinnatifidis: pinnis oblongis subserratis obtusis, radice laevi" and adding the comparative note: "*Antecedenti [P. vulgare] simillima, sed minor, & subtus glabra.*" This over-emphasis on the smooth rootstock was again displayed by Amos Eaton when, in 1818,<sup>1</sup> he stated that *P. vulgare*, "var. *virginianum*, has a naked root," though Jacob Bigelow<sup>2</sup> had given a better description of the American plant and referred to the fronds as "divided . . . by sinuses which are more acute than in the European variety."

The first post-Linnean botanist to make a really satisfactory differentiation of our plant from the European *Polypodium vulgare* was Sir William Hooker who, in 1840, considered typical *P. vulgare* almost strictly European, while in America there were two varieties: "*β. Americanum*; minus, fronde angustiore, laciniis remotioribus. *P. Virginianum*, *Linn. Sp. Pl.* p. 1345 (*excl. Syn. Plum. &c.*) . . . *γ. occidentale*; frondis laciniis acutis acute serratis. *P. vulgare, Virginianum. Bong. Veg. Sitcha*, p. 57."<sup>3</sup> Var. *americanum* was given a range through southern Canada west to the Saskatchewan and Slave River, while var. *occidentale* occurred from the mouth of the Columbia north to Sitka; and Hooker added under var. *americanum* the following illuminating comment: "The common state of this plant throughout the United States and in British N. America, is to be smaller than the European form, with narrower and more oblong fronds, with lacinae more distant, and the sori nearer the margin. This is no doubt the *P. Virginianum* of Linnaeus and authors, as far as regards the Virginia plant, on which Linnaeus founded his character." Somewhat later, in that storehouse of accurate observation, his *Flora of the State of New York*, Torrey took up var. *americanum* and in his description added the highly important character: "Segments mostly alternate, 3-4 lines wide."<sup>4</sup> Still later, in 1848, Kunze, who certainly had an intimate knowledge of European ferns, published a suggestive comment: "*P. vulgare, β. americanum. Hook., (P. virginianum, L.)* differs from the European form by a

<sup>1</sup> Eaton, *Man.* ed. 2: 373 (1818).

<sup>2</sup> Bigelow, *Fl. Bost.* 252 (1814).

<sup>3</sup> Hook. *Fl. Bor.-Am.* ii. 258 (1840).

<sup>4</sup> Torr. *Fl. N. Y.* ii. 484 (1843).

narrower and more elongated frond, narrower lobes separated by wider sinus, the lowest being longer or at least not shorter than the following ones, and the sori being always nearer the margin than in the European plant. I have not met with any American specimens entirely agreeing with the true *P. vulgare* of the old world."<sup>1</sup>

These quotations are sufficient to indicate that the most discerning of the earlier students of our ferns were convinced that no true *Polypodium vulgare* occurs in eastern America, although there was difference of judgment as to whether our plant was specifically or only varietally separable from it. Since the statements above quoted little has been consciously added to the once rapidly accumulating series of differential characters and for three-fourths of a century our plant has passed, with only desultory and inconclusive challenges, as typical *P. vulgare*. For instance, the late B. D. Gilbert stated that, "For some time past I have been inclined to look upon our so-called *Polypodium vulgare* in Eastern North America as a distinct species from the European and Pacific coast species . . . . However, I am not yet prepared to separate the two, which can only be done by one who has a large number of European as well as American specimens;"<sup>2</sup> while the English specialist, the late C. T. Druery, in 1902, assumed the identity of *P. virginianum* with European *P. vulgare* when he urged "The undesirability of attaching different names on your [American] side to varietal types which may already exist on this [European]."<sup>3</sup> In 1907, it is true, Tidestrom took up our plant as *P. virginianum*, but with only one highly inconstant character: "In its outward appearance this species differs in no appreciable degree from *P. vulgare*. The latter species is characterized by having from 3 to 5 *stelai* at the base of the petiole, while in our plant the number is commonly 2, and in older leaves 3,—2 being normal and 1 is smaller."<sup>4</sup> In such a discriminating work as Christensen's *Index Filicum*, however, *P. virginianum* appears as an unquestioned synonym of *P. vulgare*, although full specific rank is accorded *P. californicum* Kaulf., *P. falcatum* Kell. (*P. vulgare*, var. *occidentale* Hook., *P. Glycyrrhiza* D. C. Eaton, *P. occidentale* (Hook.) Maxon) and *P. hesperium* Maxon, plants so strongly resembling variants

<sup>1</sup> Kunze, Am. Journ. Sci. ser. 2, vi. 82 (1848).

<sup>2</sup> Gilbert, Fern Bull. x. 14 (1902).

<sup>3</sup> Druery, Fern Bull. x. 51 (1902).

<sup>4</sup> Tidestrom, Elysium Marianum, ed. 2: 18 (1907)

of the European *P. vulgare* that only upon the most minute but often inconstant characters can they possibly be kept apart from them.

In fact if one compares a series of typical Californian plants (for example Heller's no. 5011 or 7255, C. F. Baker's no. 235; Abrams's no. 3021 or Parish's no. 4375) with a series of the European *P. vulgare*, var. *serratum*, he will have the greatest difficulty in separating the fronds; or similarly, he will be puzzled if he compares them with such European plates as Lowe's *Our Native Ferns*, i. t. 6 (and figs. 6, 18, 21, etc.) or Moore's *Nature Printed British Ferns* (octavo ed.), i. tt. 1 and 2. Hooker & Baker in *Synopsis Filicum*, to be sure, placed *P. californicum* in the Section *Goniophlebium* with "Veins forming ample regular areolae," while *P. vulgare* was kept in *Eupolypodium* with "Veins free"; but they certainly must have been in error for, although some extreme specimens show several areolae, the veins of *P. californicum* are mostly quite free and specimen after specimen shows no difference in venation between this species and the European. Indeed, several European specimens in the Gray Herbarium, especially of *P. vulgare*, var. *serratum*, have quite as many areolae as there are in extreme Californian plants; and such "nature-printed" illustrations of the European *P. vulgare* as those of Moore's *Nature Printed British Ferns* (octavo ed.) tt. 3 D and 5 or Ettinghausen & Pokorny's *Gefässpflanzen Oesterreichs in Naturselbstdruck*, i. (t. 7) show as numerous areolae as many Californian specimens, especially those referred to *P. californicum*, var. *intermedium* D. C. Eaton, of which its author frankly stated, that "in var. *intermedium* this species [*P. californicum*] makes an inconveniently near approach to *P. vulgare*," adding the comment: "It may be noticed in this connection that Milde says of the veinlets of *P. vulgare*, var. *serratum*, 'Interdum ramos anastomosantes inveni.'"<sup>1</sup>

Similarly, the same difficulty is experienced in separating fronds of *Polypodium falcatum* (for instance, J. C. Nelson, no. 1122) from such a plate as Lowe's no. 9, representing *P. vulgare*, var. *Acutum-Stansfieldii*. In this connection it is noteworthy that, in *Synopsis Filicum*, Hooker & Baker assigned *P. vulgare* a North American range only from "Sitka, southward to California and the north of Mexico," *i. e.* they excluded, by inference, *P. virginianum* of the East and included as specifically inseparable from *P. vulgare* the western

<sup>1</sup> D. C. Eaton, *Ferns of N. A.* i. 246 (1879).

*P. falcatum* and *P. californicum*, var. *intermedium*; at the same time calling "*P. falcatum*, Kellogg (*P. glycyrrhiza*, Eaton), a Californian variety, with the pinnae finely toothed, and narrowed very gradually to an acute point."<sup>1</sup> Very similarly, Diels states the range to include in America, at least by inference, only the western region: "südlich bis Makaronesien, Nordafrika, Vorderasien, Japan, Nordmexico."<sup>2</sup>

From earliest times the European *Polypodium vulgare* has attracted the gatherers of medicinal herbs on account of its sweet roots. Gerarde in the 16th century, stated that the root "hath in it a certaine sweetenes";<sup>3</sup> Parkinson, in the 17th, said it has "a certaine sweetish harshnesse in the taste,"<sup>4</sup> Morison, in the 18th, described it with a "sweet taste (sapore dulci)";<sup>5</sup> and Diels, in the 19th, said, "Das Rhizom ('Radix polypodii S. filiculae dulcis'—'Engelsüss') enthält Zucker."<sup>6</sup> In view of the many indications of specific identity between the Polypodies of western America and the European *P. vulgare* it is not surprising, therefore, to find in Kellogg's original account of *P. falcatum* the statement that the rootstock has a "sweetish liquorice flavor";<sup>7</sup> that D. C. Eaton, publishing the same species almost simultaneously gave it the name *P. Glycyrrhiza*, with "Rootlets aerial, having a sweet flavor like that of liquorice";<sup>8</sup> that by Piper & Beattie it is called *Licorice-root Fern* because "The rootstocks taste much like licorice, and are eaten by children";<sup>9</sup> and that Maxon, in describing as a species of the western mountains *P. hesperium*, stated that, "It is doubtful whether *hesperium* is very closely related to the eastern *vulgare*. Its affinities seem rather to lie with the Polypodiums of the Pacific coast, one especially notable feature which it possesses in common with them being the hard licorice-like rootstock. The rhizomes of the eastern *vulgare*, on the other hand, are not only spongy and quite acrid but more or less unsavory in taste."<sup>10</sup>

The only character which I have thus far been able to discover, by which *Polypodium californicum*, *P. falcatum* and *P. hesperium*

<sup>1</sup> Hook. & Baker, Syn. Fil. 334 (1868).

<sup>2</sup> Diels in Engler & Prantl, Pflanzenf. i. Ab. 4: 311 (1899).

<sup>3</sup> Gerarde, Herball, 972 (1597).

<sup>4</sup> Parkinson, Theatrum Botanicum, 1040 (1640).

<sup>5</sup> Morison, Pl. Hist. iii. 562 (1715).

<sup>6</sup> Diels, l. c. (1899).

<sup>7</sup> Kellogg, Proc. Cal. Acad. i. 20 (1854).

<sup>8</sup> D. C. Eaton, Am. Journ. Sci. ser. 2, xxii. 138 (1856).

<sup>9</sup> Piper & Beattie, Fl. N. W. Coast, 3 (1915).

<sup>10</sup> Maxon, Proc. Biol. Soc. Wash. xiii. 200 (1900).

can be separated from most European *P. vulgare*, is in the scales of the rhizome. In most of the European plants the scales are very prolonged into a capillary tip; in the plants of Pacific America they are less prolonged. But such plants as those distributed by Dörfler in his *Herbarium Normale* as no. 3687, *P. vulgare*, forma *variegata* from Germany, have the scales quite like those of the western American plants; and certainly there is nothing to separate this German material specifically from such representatives of *P. californicum* as *Abrams & McGregor's* no. 31 from Ventura Co., California, *Kellogg & Harford's* no. 1164 from Lone Mountain, California, *Heller's* no. 13,090 from Butte Co. or his no. 5030 from Sonoma Co., *Parish's* no. 4373 from San Bernardino Co., or *Abrams's* no. 3100 from San Diego Co. Similarly Dörfler's no. 3687 is quite as indistinguishable from such representatives of *P. falcatum* as *Bongard's* Sitkan material sent out as *P. vulgare*, *virginianum*, *Funston's* no. 13 from Yakutat Bay, *Eastwood's* no. 798 from Shagway or *G. R. Vasey's* no. 42 from Washington, the latter all originally and correctly distributed as *P. vulgare* but specifically inseparable from plants passing as *P. falcatum*.

In European *Polypodium vulgare* and the western American *P. californicum*, *P. falcatum* and *P. hesperium* the scales of the rhizome, though varying in different plants from pale-cinnamon to dark brown, are individually of tolerably uniform color throughout and (under high magnification) show a similarly close cellular structure with thin cell-walls; in the eastern American *P. virginianum*, on the other hand, the scales commonly have a deeper-colored median band and they are of much looser or more open structure, and the cell-walls are thickish. The late D. C. Eaton, leaning too confidently upon European authors, described the rootstock of the eastern American plant as "covered with ovate-acuminate brownish chaffy scales, peltately attached near the base;"<sup>1</sup> but as Miss Slosson points out in her description of the eastern plant: "I find a sinus leading from the base to the point of attachment. An over-lapping of the sides of this sinus often makes the scales appear peltately attached."<sup>2</sup> Miss Slosson thus accurately describes the basal scales of *P. virginianum*, while Eaton's description accords with that of European

<sup>1</sup> D. C. Eaton, *Ferns N. A.* i. 239 (1879).

<sup>2</sup> Slosson, *How Ferns Grow*, 49 (1906).

authors when describing their plant, for example Luerssen who definitely calls the scales "schildförmig."<sup>1</sup> Careful comparison of scales from the two plants shows this to be a constant character and, as would be expected, the scales of the western American *P. californicum*, *P. falcatum* and *P. hesperium* agree with the European *P. vulgare* in being peltately attached just above their base.

Reference has been made to Tidestrom's statement that *P. virginianum* differs from *P. vulgare* in having only 2 or 3 vascular bundles at the base of the stipe, two of them large, the third smaller; while in *P. vulgare* there are said to be 3 to 5 bundles. Luerssen<sup>2</sup> somewhat similarly describes *P. vulgare* as having at the base of the stipe 2 large and 2 smaller bundles, while Waters<sup>3</sup> definitely places our plant in his section with "Bundles three at extreme base." Whether there is any pronounced difference in the number and arrangement of the bundles cannot be determined without more adequate European material; but it is significant that some dried European plants, in which the stipe has been severed just above the base, seem to show only 2 bundles while others show but 3.

The habitats of *Polypodium vulgare* and of *P. virginianum* are usually very different. Although some forms occur on rocks or on mossy banks or even sand dunes,<sup>4</sup> a common habitat in Europe is tree-trunks (either living or dead), old stumps and fallen logs. The early European herbalists, for instance Gerarde in the 16th century, distinguished "*Polypodium Quercinum* Polipodie of the Oke," which occurs "in the tops of the trunks of trees in thicke woods";<sup>5</sup> Kerner von Marilaun in his popular compilation, the *Natural History of Plants (Pflanzenleben)*, says: "*Polypodium vulgare* is often met with enveloping the trunks and boughs of large trees";<sup>6</sup> Luerssen briefly states its habitat in continental Europe: "Auf Baumwurzeln und Baumstumpfen, moosbewachsenen Felsblocken, an alten Mauern und in Felsspalten";<sup>7</sup> while Lowe gives the following vivid picture from Great Britain: "Looking higher up the tree, an epiphyte in the shape of a Fern has taken possession, and is clothing the forks from

<sup>1</sup> Luerssen, *Farnpfl.* 54 (1889).

<sup>2</sup> Luerssen, *Farnpfl.* 55 (1889).

<sup>3</sup> Waters, *Ferns*, 73 (1903).

<sup>4</sup> Warming, *Oecology of Plants*, ed. Groom & Balfour, 267 (1909).

<sup>5</sup> Gerarde, *Herball*, 974 (1597).

<sup>6</sup> Kerner von Marilaun, *Nat. Hist. Pl.* ed. Oliver, ii. 705 (1895).

<sup>7</sup> Luerssen, *Farnpfl.* 55 (1889).

where the branches spring; and this Fern is the Common Polypody. It is a Fern that delights to run along the ground amongst old wood and moss . . . . It may justly be called a parasite—or rather an epiphytal plant—which seeks to hasten to destruction those trees where decay has made its appearance . . . . A group of pollard willows clothed with *Polypodium vulgare* are [is] both singular and interesting.”<sup>1</sup> Similarly, the Pacific American varieties of *P. vulgare* delight in mossy carpets, old stumps and tree-trunks. Thus Watson, in the *Botany of California* speaks of *P. vulgare* as “often growing on trees” and *P. falcatum* “On trees and sometimes on rocks”;<sup>2</sup> Macoun & Burgess speak of *P. falcatum* as “frequent in the hollows of living trees”;<sup>3</sup> Piper & Beattie assign *P. occidentale* to “moss on rocks, logs and trees”;<sup>4</sup> while Henry says of *P. vulgare*: “Often on mossy trees and logs”.<sup>5</sup>

How different from the ordinary habitat of *Polypodium virginianum*, which is accurately described in many books on the eastern American ferns. Thus Waters says that *P. virginianum* “prefers the top of a shaded ledge of rocks”;<sup>6</sup> Miss Slosson likewise says: “Flat or slightly sloping surfaces of rocks, woodland banks, stone walls, etc.”;<sup>7</sup> while Clute equals Lowe in his vivid account: “Wherever there is a shaded ledge of rocks in the northeastern States one is almost sure to find the polypody . . . . There is no question as to choice of location with this sturdy species. All are alike to it, provided there are rocks upon which it can grow. The only preference it has is for the tops and upper shelves of the rocks where the soil is moderately dry. So characteristic is it in such situations that when one sees a fern clad rocky summit from a distance too great to discern the individual fronds he identifies them with confidence as this species.”<sup>8</sup> In fact so generally is *P. virginianum* of eastern America a plant of rock-habitats or woodland banks that, when it is rarely found as an epiphyte it at once attracts attention. Thus when the late Lester F. Ward, in 1878, discovered it as an epiphyte on *Betula nigra*, he was so interested

<sup>1</sup> Lowe, *Our Native Ferns*, i. 24, 25 (1867).

<sup>2</sup> Watson, *Bot. Cal.* ii. 334 (1880).

<sup>3</sup> Macoun & Burgess, *Trans. Roy. Soc. Can.* ii. Sect. iv. 181 (1884).

<sup>4</sup> Piper & Beattie, *Fl. N. W. Coast*, 3 (1915).

<sup>5</sup> J. K. Henry, *Fl. So. Brit. Columb.* 3 (1915).

<sup>6</sup> Waters, *Ferns*, 79 (1903).

<sup>7</sup> Slosson, *How Ferns Grow*, 51 (1906).

<sup>8</sup> Clute, *Our Ferns in their Haunts*, 196 (1901).

in the novel habitat that he specially recorded the discovery, the Polypody growing on the "trunk several feet above the base, after the manner of *P. incanum* . . . The roots have taken a firm hold in the clean living bark, so that I collected my specimens with a knife, leaving the bark attached."<sup>1</sup> In 1884, in their paper on *Canadian Filicineae*, after stating the range and the ordinary habitat of the plant in Canada, Macoun & Burgess added as a noteworthy item: "growing plentifully on old elm trees, near Belleville, Ont., near Heely Falls, Trent River, Northumberland Co., Ont., and near Amherstburg, Essex Co., Ont."<sup>2</sup> In 1903 Waters<sup>3</sup> published a photograph, taken apparently near Baltimore, of "The Polypody at the Base of a Tree". In September, 1906, Professor J. Franklin Collins showed me at Lincoln, Rhode Island, several trees of *Betula lenta* with festoons of Polypody hanging from the lower halves of the trunks, and he was so interested in the novelty that he photographed the colony; and similar occurrences in Nova Scotia, observed in 1920, seemed so unusual as to merit the note: "*Polypodium vulgare* [i. e. *P. virginianum*], here having no rocks to grow on, was climbing the tree-trunks, the creeping rootstocks ascending in the crevices of the bark to a height of 2 or 3 meters" and at another station "the tree-climbing *Polypodium* again."<sup>4</sup> Almost simultaneously, Professor Duncan S. Johnson discussed in some detail the occurrence of the eastern American Polypody on trees near Baltimore, this habitat being so unusual in his experience that he had "not been able to find a definite report of its being really epiphytic in habit in the United States."<sup>5</sup> In Europe and Pacific America, then, although often occurring on mossy rocks and wooded banks, *P. vulgare* is frequent on living or dead trees; but the eastern American *P. virginianum*, though very rarely epiphytic, is ordinarily a plant of rock-habitats.

In view of the similarly stout and firm, sweetish rhizome with peltately attached scales of similarly dense structure, the identical fronds with often very broad pinnae (up to 1.8 cm. and rarely to 4 cm.) bearing median sori, the clearly intergrading venation, and the

<sup>1</sup> L. F. Ward, *Field and Forest*, iii. 150 (1878) and report in *Bull. Torr. Bot. Cl.* vi. 238 (1878).

<sup>2</sup> Macoun & Burgess, *Trans. Roy. Soc. Can.* ii. Sect. iv. 181 (1884).

<sup>3</sup> Waters, *Ferns*, 82 (1903).

<sup>4</sup> Fernald, *RHODORA*, xxiii. 147, 149 (1921).

<sup>5</sup> D. S. Johnson, *Bot. Gaz.* lxxii. 237 (1921).

predilection for living or dead trees, stumps and mossy logs, the plants of western America are certainly specifically inseparable from the endlessly variable *P. vulgare* of Europe. Their ranges on the two continents are so strikingly similar to those of *Blechnum Spicant* (L.) Sm. (western Eurasia, north Africa and the Atlantic Islands; southern Alaska to California) and *Equisetum maximum* Lam. (*E. Telmateia* Ehrh.) (western Eurasia, north Africa and the Atlantic Islands; British Columbia to southern California) that absolutely no violence is done the probabilities of truth by treating them as one species; and, until they are shown to have stronger characters than their supporters have yet pointed out, it would seem only the part of sound classification so to treat them. Diels has expressed almost this conclusion by saying, "*P. californicum* Kaulf. (pacifisches Nordamerika) kommt dem *P. vulgare* L. so nahe, dass es nur durch die (noch dazu nicht überall constante) Maschenbildung davon zu trennen ist";<sup>1</sup> Schur, describing the European *P. vulgare*, var. *transsilvanicum* made the note: "An *P. vulgare*, var. *occidentale* Hook";<sup>2</sup> Eaton, describing *P. californicum*, var. *intermedium*, practically admitted that he could not separate it from the European *P. vulgare*, var. *serratum*; Hooker & Baker gave up the attempt to keep *P. falcatum* distinct from European forms of *P. vulgare*; and Maxon, in publishing *P. hesperium* as a species, suggested the possibility "that the species here described is identical with the var. *rotundatum* [of *P. vulgare*] of Milde."

Neither *Blechnum Spicant* nor *Equisetum maximum* extend eastward far beyond the limits of Europe. It is, therefore, significant to note Hooker's statement<sup>3</sup> of the Eurasian range of *Polypodium vulgare*: "Europe, to its extreme south; North Africa, Madeira, Canaries, and Azores . . . ; Siberia, the Amur, Manchuria, Japan (unknown in the tropical continent of Asia, or even in the Himalaya). From Erzeroum, Asiatic Turkey, I possess specimens." In other words, except from an indefinite "Siberia," the species was not known to Hooker from between Europe and adjacent Asia Minor and "the Amur, Manchuria, Japan." Ledebour, in *Flora Rossica*,<sup>4</sup> cites Siberian material only from the Ural (on the Russian

<sup>1</sup> Diels in Engler & Prantl, Pflanzenf. i. Ab. 4: 312 (1899).

<sup>2</sup> Schur, En. Pl. Transsilv. 830 (1866).

<sup>3</sup> Hook. Sp. Fil. iv. 205 (1862).

<sup>4</sup> Ledeb. Fl. Ross. iv. 508 (1853).

border), then from the Altai eastward across the Baikal region to Kamchatka. I have seen no Altai nor Japanese material and it is probable that all the Japanese plant is referable to *P. Fauriei* Christ, Bull. Herb. Boiss. iv. 672 (1896). (*P. vulgare*, var. *japonicum* Franchet & Savatier, Enum. Pl. Jap. ii. 244 (1879); *P. japonicum* (Franch. & Sav.) Maxon, Fern Bull. x. 42 (1902), not Houtt. (1783)). The plant of Amur and Manchuria, however, well shown in the Gray Herbarium, is neither European *P. vulgare* nor the Japanese *P. Fauriei* but is a good match in all characters for the eastern American *P. virginianum*.

This specific identity of the Polypody of Amur and Manchuria with the plant of eastern America, while the western American species prove to be inseparable from the European, is so exactly what we have learned to expect, that in itself it is some indication that we are dealing with two distinct species; and the various characters already discussed lead inevitably to the conclusion that *P. vulgare* and *P. virginianum* are separated by many fundamental differences.

Another point worthy of brief note is the comparative variability of the two. In Europe *Polypodium vulgare* is so exceedingly given to the production of varieties and sports that it, along with the European and western American *Blechnum Spicant* and *Athyrium Filix-femina*,<sup>1</sup> supplies a large proportion of the 1119 varieties of ferns recognized in the British Isles alone in Lowe's *British Ferns, and where Found*. The fact that, to quote Druery, "This species has been very liberal in 'sports',"<sup>2</sup> supplemented by the infectious charm of the couplet,

"How wonderfully you vary,  
*Polypodium vulgare*."

has stimulated the fern lovers of eastern America to emulate their British cousins in searching for these so-called varieties. The result is well stated by Waters in the words: "The common polypody [of eastern America, i. e. *P. virginianum*] is not ordinarily a variable fern."<sup>3</sup> How different from Druery's statement just quoted or that of Mr. James Britten, in writing of the European plant: "The Poly-

<sup>1</sup> "in the eastern United States and Canada there are two distinct species of lady ferns, neither of which is conspecific with *A. Filix-femina* (L.) Roth of Europe .

. the ferns of the northwest are conspecific with the European plant, but, in some cases, differ from the common European forms of *A. Filix-femina* in certain minor points"—Butters, RHODORA, xix. 178, 179 (1917).

<sup>2</sup> Druery, Brit. Ferns, 172 (1910).

<sup>3</sup> Waters, Ferns, 81 (1903).

pody is a very variable species."<sup>1</sup> Discussion of the larger bearings of this difference, which the writer is considering in another paper, would lead us now too far afield; but the conclusion which immediately concerns us is, that the profound difference in the variability of the Polypodies of the two sides of the Atlantic, as well as on the two slopes of the North American continent, is due to the fact that they are two distinct species of quite different geological and geographic history and distribution.

The diagnostic characters of the two species and their American variations are shown below.

- Rhizome firm, sweet, in American forms commonly 0.5–1 cm. thick; its pale-cinnamon to castaneous scales uniformly colored (or darker toward the base), densely cellular, with thin cell-walls, peltately attached slightly above the base, 0.5–1 cm. long; stipes (except in the smallest extremes) 1–3 mm. in diameter, 0.2–3 dm. long: fronds 0.2–5.5 dm. long, 0.1–2.4 (av. 1.1.) dm. broad: pinnae opposite, subopposite or alternate, the lowest commonly shorter than the middle ones; the latter 0.2–2 (in var. *cambricum* –4.5) cm. broad, their midribs commonly curving at base: sori commonly median . . . . . 1. *P. vulgare*.
- Rhizome rather soft and spongy, not sweet, 2–7 mm. thick; its scales darkened on the back, loosely cellular, with thick cell-walls, cordate at base, often with a closed sinus, 2–4.5 mm. long; stipes 0.6–1.7 mm. in diameter, 0.1–2 dm. long: fronds 0.25–2.6 dm. long, 1.5–7 (av. 4) or in very unusual forms –11 cm. broad: pinnae alternate, or the lowest subopposite, usually about as long as or slightly longer than the median; the latter 2–8 (in very unusual forms –11) mm. broad, their midribs and those of the upper pinnae straight: sori nearly marginal . . . . . 2. *P. virginianum*.

1. POLYPODIUM VULGARE L. Sp. Pl. ii. 1085 (1753). *P. californicum* Kaulf. Enum. 102 (1824). *P. vulgare*, var. Bong. Vég. Sitch. 175 (1832). *Marginaria californica* (Kaulf.) Presl, Tent. Pterid. 188 (1836). *P. vulgare*,  $\gamma$  *occidentale* Hook. Fl. Bor.-Am. ii. 258 (1840). *P. intermedium* Hook. & Arn. Bot. Beech. Voy. 405 (1841). *P. falcatum* Kellogg, Proc. Cal. Acad. i. 20 (1854). *P. Glycyrrhiza* D. C. Eaton, Am. Journ. Sci., ser. 2, xxii. 138 (1856). *Goniophlebium californicum* (Kaulf.) Moore, Ind. Fil. 386 (1862). *P. californicum*, vars. *Kaulfussii* and *intermedium* (Hook. & Arn.) D. C. Eaton, Ferns N. A. i. 244 (1879). *P. hesperium* Maxon, Proc. Biol. Soc. Wash. xiii. 200 (1900). *P. occidentale* (Hook.) Maxon, Fern Bull. xii. 102 (1904).—Europe and adjacent Asia and north Africa; Atlantic Islands; Alaska to Lower California, Arizona and New Mexico.

In North America the following varieties are recognizable, though

<sup>1</sup> Britten, Europ. Ferns, 165 (1881).

several herbarium-sheets show them variously mixed under one number and intergradient individuals are numerous.

Var. *COMMUNE* Milde, Fil. Eu. Atl. 18 (1867). *P. vulgare* (typical).—Fronde lanceolate, of firm texture, 0.7–2.5 dm. long, 3–9 cm. broad; with subacute to obtuse oblong crenate or minutely serrulate pinnae, the longer 1.5–4.5 cm. long, 0.4–1 cm. broad.—Northern and central Europe; Alaska to Oregon. The following are characteristic. ALASKA: rocks, Nagai Island, Shumagin Islands, July 27, 1872, *M. W. Harrington*; near the Mission, Yakutat Bay, June 6, 1892, *Funston*, no. 13; Sitka, *Bongard, Bischoff*; trail to the lakes, Skagway, July 20, 1914, *Eastwood*, no. 798. WASHINGTON: moss on trees, Quiniault Valley, June 20, 1902, *H. S. Conard*, no. 107; Castle Rock, Cowlitz Co., October 31, 1902, *Piper*. OREGON: Hood River, Wasco Co., May 26, 1910, *Heller*, no. 10,095; Elk Rock, Multnomah Co., November 24, 1902, *E. P. Sheldon*, no. 11,342; Calapooya Valley, Douglas Co., July 26, 1899, *M. A. Barber*, no. 122.

The extreme of the var. *commune* with the pinnae strongly rounded at tip is sometimes distinguished as forma *rotundatum* Milde, Gefäss-Crypt. Schlesien, 631 (1858). Var. *rotundatum* Milde, Fil. Eu. Atl. 18 (1867). In publishing var. *rotundatum* Milde made it perfectly clear that the plant of Alaska with round-tipped pinnae was in his mind, giving the range: "Non raro in Europa bor.—Unalaska. Kadjak. Sitcha."

Var. *COLUMBIANUM* Gilbert, Working List N. A. Pterid. 19, 38 (1901).—Fronde firm, narrowly oblong, 0.5–2 dm. long, 2–4.2 cm. broad: the 7–18 pairs of mostly alternate round-tipped obscurely to deeply crenate pinnae oblong-elliptical to narrowly obovate, the median and lower usually of about uniform length; the longer 1–2 cm. long, 0.5–1.2 cm. broad.—Var. *rotundatum* E. G. Britton, Fern Bull. vii. 35 (1899), not Milde. *P. hesperium* Maxon, Proc. Biol. Soc. Wash. xiii. 200 (1900). Var. *hesperium* (Maxon) Nelson & Macbride, Bot. Gaz. lxi. 30 (1916).—In the mountains, British Columbia to Montana and the Black Hills of South Dakota, south to Colorado, Utah and Oregon. The following are characteristic. BRITISH COLUMBIA: Fraser River, *Wallace*; within five miles of Lillooet, July, 1916, *J. M. Macoun*, nos. 93,250, 93,251. MONTANA: Big Fork, July 24, 1908, *Mrs. J. Clemens*. WYOMING: dry granite cliffs, Crow Creek, Albany Co., July 8, 1903, *A. Nelson*, no. 8902. COLORADO: Hardscrabble Canyon, Custer Co., August, 1898, *H. M. M.* UTAH: Cottonwood Canyon, August, 1869, *Watson*, no. 1357. OREGON: basaltic cliffs, Bingham Springs, Umatilla River, July 17, 1908, *Cusick*, no. 3287. WASHINGTON: Wenatchie region, July, 1883, *Brandege*, no. 1208; Stehekin, Lake Chelan, July 5, 1901, *Whited*, no. 1392; rocks, Cape Horn,

August 18, 1894, *Suksdorf*, no. 2336; crevices of rock, Mt. Baldy, July 7, 1902, *Conard*, no. 288.

When he published var. *columbianum*, Gilbert at least knew of *P. hesperium* for he included it in his *List*, but all the points emphasized by him: "the short stipes and narrow fronds, the very glandular surfaces, the odd pinna at base of frond, the deep lobations of lower pinnae, and the occasionally green-gold hue of lower surface," are found in one specimen or another of *P. hesperium*. The measurement of the fronds nearly coincide with those originally given for *P. hesperium* ("6 to 13 cm. long, 2 to 3½ cm. broad."—Gilbert; 3 to 8 inches [7.3 to 19.6 cm.] long, 1 to 1¾ inches [2.4 to 7.2 cm.] broad—Maxon); the glandularity of the frond is extremely variable, though Maxon originally indicated some glandularity for *P. hesperium*; and the alternate pinnae (and consequently "odd pinna at base of frond") were specially emphasized by Maxon and they were described with "margins obscurely (or less often, decidedly) crenate."

When he published *P. hesperium* as a species, Maxon said, "It is barely possible, but hardly probable, that the species here described is identical with the var. *rotundatum* of Milde." Surely the larger development of the plants (such as G. R. Vasey's no. 41 or Whited's no. 1392 from Lake Chelan, the type region of *P. hesperium*) are difficult to distinguish from var. (or forma) *rotundatum* and Mr. J. K. Henry (Fl. So. Brit. Columb. 2) reduces them outright; but the pinnae are too broad and short to satisfy Luerssen's requirement (Farnpfl. 56) of pinnae "linealisch oder länglich-linealisch;" and although the larger plants closely approach Alaskan and Norwegian specimens of forma *rotundatum*, var. *columbianum* may stand as a fairly differentiated extreme of the western mountains. In its narrower forms passing insensibly to

Var. *PERPUSILLUM* Clute, Fern Bull. xviii. 98 (1910).—Fronds coriaceous, linear-oblong, 0.3–1.7 dm. long, 1–2 cm. broad; their 6–22 pairs of remote alternate pinnae 2–5 mm. wide.—Mountains of Colorado, New Mexico and Arizona. COLORADO: *Brandegee*. NEW MEXICO: lower side of cliff, vicinity of Brazos Canyon, Rio Arriba Co., August 20, 1914, *Standley & Bollman*, no. 10,626.

Var. *PYGMAEUM* Schur, Enum. Pl. Transsilv. 830 (1866).—Stipe 1–7 cm. long, slender: frond ovate-lanceolate, ovate or deltoid, 2–8 cm. long, 2–3 cm. broad, with only 1–7 pairs of broad-oblong to narrowly ovate round-tipped pinnae or segments.—Forma *pumilum* Haussm. ex Luerss. Farnpfl. 58 (1889).—The following American

specimens, all from ARIZONA, seem quite like European material: Maple Canyon Falls, Huachuca Mts., 1882, *Lemmon*; dry shaded crevices, north side of cliffs, Miller Canyon, Huachuca Mts., 1909, *Goodding*, no. 123 (distributed as *P. hesperium*); without statement of locality, 1903, *J. H. Ferriss*; moist rocks at 8000 ft., Rincon Mts., 1909, *Blumer*, no. 3439.

Var. OCCIDENTALE Hook. Fl. Bor.-Am. ii. 258 (1840).—Fronds elongate, broad-lanceolate, usually of thin texture, 1–5.5 dm. long, 0.6–2 dm. broad, with 10–36 pairs of narrowly lanceolate, attenuate or acute finely serrate or serrate-dentate pinnae.—*P. falcatum* Kellogg, Proc. Cal. Acad. i. 20 (1854). *P. Glycyrrhiza* D. C. Eaton, Am. Journ. Sci. ser. 2, xxii. 138 (1856). Var. *falcatum* (Kellogg) Christ, Beitr. Krypt. Schweiz. i. Heft. 2: 51 (1900). *P. occidentale* (Hook.) Maxon, Fern Bull. xii. 102 (1904).—Southern Alaska to northern California. ALASKA: dry rocky beach, Tongas Village, August 3, 1915, *Walker*, no. 888 in part (mixed with var. *commune*). BRITISH COLUMBIA: Skidegate, Queen Charlotte Islands, June 13, 1910, *Spreadborough*, no. 94,847; New Westminster, 1899, *A. J. Hill*; Brackendale, June 15, 1916, *J. M. Macoun*, no. 93,246; Goldstream, Vancouver I., May 18, 1887, *J. Macoun*; on tree-trunks, mostly alder, District of Renfrew, 1901, *Rosendahl & Brand*, no. 98. WASHINGTON: mossy rocks and logs, August 20, 1888, *F. Binns*; Friday Harbor, San Juan Islands, 1917, *Zeller*, no. 794; old rotten logs in mossy woods, Tacoma, November 13, 1898, *Flett*. OREGON: Sauvies Island, *J. Howell*; on tree-trunks, Coos Bay, *Lemmon*; moss-covered trees, Coos River, October 29, 1881, *Pringle*; rocky woods, Salem, May 9, 1917, *J. C. Nelson*. CALIFORNIA: Charlotta, Humboldt Co., June, 1915, *E. P. Hawver*; Feather River, Butte Co., March 29, 1919, *Heller*, no. 13,089.

The extreme plant (var. *falcatum*) with very long-attenuate pinnae seems to be practically if not quite the European var. *transsilvanicum* Schur, Enum. Pl. Transsilv. 830 (1866), which was described: "Elatum 12–15 poll. Fronde ambitu lanceolata, utrinque viridi; laciniis lineari-oblongis, 3 poll. long. 3–4 lin. latis, a media sensim acuminatis, acutis, manifeste serratis," with the discriminating comment by Schur: "An *P. vulgare* var. *occidentale* Hook." It is also very close to the European var. *attenuatum* Milde, Fil. Eur. Atl. 18 (1867) and to var. *Acutum-Stansfieldii* Lowe, Our Native Ferns, i. 28, t. 9 (1867).

Var. **intermedium** (Hook. & Arn.), n. comb.—Fronds ovate to ovate-oblong, herbaceous to membranaceous, 1–3.5 dm. long, 0.6–1.2 dm. broad, with 6–23 pairs of oblong or oblong-linear coarsely serrate, crenate or subentire acute to obtuse pinnae 0.6–1.8 cm. broad.—*P. intermedium* Hook. & Arn. Bot. Beech. Voy. 405 (1841). *P. californi-*

*cum*, var. *intermedium* (Hook. & Arn.) D. C. Eaton, Ferns N. A. i. 244, t. 31, fig. 4. (1879).—Oregon to Lower California. OREGON: Multnomah Co., October, 1877, *Howell*. CALIFORNIA: Feather River, Butte Co., March 29, 1919, *Heller*, no. 13,090; Little Chico, March 10, 1897, *Mrs. R. M. Austin*, no. 1868; hills near Santa Rosa, Sonoma Co., March 10, 1902, *Heller*, no. 5011; open banks of Sonoma Creek, May 23, 1902, *Heller*, no. 5030; large mats on boulders and ledges, King's Mountain, San Mateo Co., January 15, 1902, *Baker*, no. 235; Stockton Pass, May 4, 1879, *L. G. Yates*; Santa Cruz, 1873, *Anderson*; foothills west of Los Gatos, Santa Clara Co. March 5, 1904, *Heller*, no. 7255; San Luis Obispo Co., 1886, *M. M. Miles*; Sulphur Mountains, Ventura Co., June, 1908, *Abrams & McGregor*, no. 31; near San Bernardino, May, 1894, *Parish*, no. 2824. LOWER CALIFORNIA: Guadalupe Island, 1889, *Palmer*, no. 857.

The Pacific American representative of var. *serratum* Willd. of southern Europe, the Mediterranean region and the Atlantic Islands. Differing chiefly in the scales of the rhizome, which are usually shorter and less attenuate than in var. *serratum*. When he published *P. californicum* var. *intermedium*, Eaton commented on it as making "an inconveniently near approach to *P. vulgare*" and at the same time quoted Milde as remarking "of the veinlets of *P. vulgare*, var. *serratum*, 'Interdum ramos anastomosantes inveni,' " the character chiefly relied upon to keep *P. californicum* separate from *P. vulgare*. Azorean specimens (for instance, Ponta Delgada, *Ware*) of var. *serratum* certainly show quite as many areolae as any Californian plants.

Var. INTERMEDIUM, forma **projectum**, n. f., pinnis mediis imisque inequaliter abbreviatis subtruncatis, costis excurrentibus. CALIFORNIA: Chico Canyon, Butte Co., December 29, 1902, *E. B. Copeland*, no. 2749 (TYPE in Gray Herb.).

Var. **Kaulfussii** (D. C. Eaton), n. comb. Fronds ovate to ovate-oblong, coriaceous, 0.5–2.1 dm. long, 0.4–1.3 dm. broad, with 7–15 pairs of oblong to oblong-linear obtuse to acutish serrate, crenate or subentire pinnae 0.7–1.2 cm. broad: veinlets more often anastomosing than in most varieties.—*P. californicum* Kaulf. Enum. Fil. 102 (1824); *P. californicum*, var. *Kaulfussii* D. C. Eaton, Ferns N. A. i. 244 (1879).—California and Lower California. The following are characteristic. CALIFORNIA: Berkeley, March 1, 1891, *Blankinship*; vicinity of San Bernardino, March 23, 1897, *Parish*, no. 4347; Los Angeles, July, 1879, *James*; Del Mar, April 4, 1914, *Clements*, no. 3; near mouth of San Gabriel Canyon, San Diego Co., March 13, 1903, *Abrams*, no. 3120. LOWER CALIFORNIA: Guadalupe Island, 1875, *Palmer*, no. 103, March–June, 1897, *Anthony*, no. 256.

Closely simulating the more coriaceous extreme of var. *serratum* of southern Europe; differing from it chiefly in the shorter and less attenuate scales of the rhizome.

Var. **CAMBRICUM** (L.) Willd. Sp. Pl. v. 173 (1810).—Fronde ovate or ovate-oblong, 2–2.5 dm. long, 1–2 dm. broad; its pinnae or many of them up to 1 dm. long and 4 cm. broad, deeply and irregularly pinnatifid or lacerate.—*P. cambricum* L. Sp. Pl. ii. 1086 (1753). *P. australe* Fée, Gen. Fil. 236, t. 20A, fig. 2 (1850–52). Var. *hibernicum* Moore, Handb. Brit. Ferns, ed. 2: 44 (1853).—Western Europe; Portland Inlet, British Columbia, acc. to Burgess, Trans. Roy. Soc. Can. ii. Sect. iv. 10 (1886).

2. **P. VIRGINIANUM** L. Sp. Pl. ii. 1085 (1753) as to Virginian plant; Tidestrom, Elys. Marianum, ed. 2: 18 (1907). *P. vulgare*, var. *virginianum* (L.) Eaton, Man. ed. 2: 373 (1818). *P. vulgare*,  $\beta$ . *americanum* Hook. Fl. Bor.-Am. ii. 258 (1840); Torr. Fl. N. Y. ii. 484 (1843); Kunze, Am. Journ. Sci. ser. 2, vi. 82 (1848). *P. vulgare* of eastern Am. authors, not L.—Shaded rocks, woodland banks and rarely tree-trunks, Newfoundland to Manitoba and northeastern Alberta, south to the mountains of northern Georgia and Alabama, Illinois and eastern Missouri. The following are characteristic illustrations: Eaton, Ferns N. A. i. t. 31, fig. i (1879). Clute, Our Ferns in their Haunts, 196 and t. 6 (1901); Waters, Ferns, 78 and 80 (1903).

No true varieties of *P. virginianum* are known. The following minor forms are recognizable.

Forma **acuminatum** (Gilbert), n. comb. *P. vulgare acuminatum* Gilbert, Fern Bull. x. 13 (1902). *P. vulgare*, var. *angustum* of Am. authors, not Muell. *P. vulgare*, var. *attenuatum* Am. authors, not Milde.

Forma **elongatum**, (Jewell), n. comb. *P. vulgare*, forma *elongata* Jewell, Maine Woods, xxx. no. 31: 3 (1908).

Forma **brachypterum** (Ridlon), n. comb. *P. vulgare*, forma *rotundatum* Ridlon, Am. Fern Journ. xi. 48, t. 1 (1921), not Milde. *P. vulgare*, forma *brachypterum* Ridlon, Am. Fern Journ. xi. 122 (1922).

Forma **subsimplax**, n. f., laminis subsimplicibus lineari-lanceolatis 7–9 cm. longis 0.7–1 cm. latis crenatis basi undulatis.—NEW HAMPSHIRE: on top of a rock, Intervale, July, 1911, *Anna I. Rodliff* (TYPE in Gray Herb.).

Forma **deltoideum** (Gilbert), n. comb. *P. vulgare*, formae *deltoideum* and *hastatum* Gilbert, Fern Bull. xiv. 37 (1906). *P. vulgare*, var. *auritum* Buchheister, Am. Bot. v. 56, fig. 3 (1903), not Willd. nor Gilbert. *P. vulgare*, forms, Clute, Fern Bull. xviii. 48, figs. 1, 2 and 3 (1910).

Forma **bipinnatifidum**, n. f., pinnis plus minusve pinnatifidis.—

TYPE: Western Mountain, Mt. Desert Island, Maine, August, 1902, Miss E. L. Shaw in Gray Herb.

This form includes the plants referred in eastern America to *P. vulgare*, vars. *cambricum* (L.) Willd., *semilacerum* Moore and *sinuatum* Willd. It is well illustrated by Waters, Ferns, 83 (1903), and by Buchheister, Am. Bot. v. 55, fig. 1 and 57, fig. 4 (1903).

Forma **chondroides**, n. nom. *P. vulgare*, var. *bifido-multifidum* Gilbert, Fern Bull. xiv. 39 (1906), not Druery.

Forma **alato-multifidum** (Gilbert), n. comb. *P. vulgare*, var. *alato-multifidum* Gilbert, Fern Bull. xiv. 105 (1906).

Forma **Churchiae** (Gilbert), n. comb. *P. vulgare*, var. *Churchiae* Gilbert, Fern Bull. xiv. 39 (1906).

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## CALAMAGROSTIS CANADENSIS AND SOME RELATED SPECIES.

O. L. INMAN.

THE species of the boreal genus *Calamagrostis* have always been difficult to separate. This has been especially true in those groups of species where the habit of the inflorescence has been used as a key-character; to a great extent the density of the panicle is determined by age, young panicles of *C. canadensis*, for example, having loosely spreading branches, while the old panicles are dense, with closely appressed branches.

In an attempt to determine if there are more fundamental characters in the section including *Calamagrostis canadensis* (Michx.) Nutt. and closely related species—see Kearney, Bull. U. S. Div. Agrost. 11: 26-31 (1898)—the abundant material at the Gray Herbarium has been studied, and it has been found that the spikelets, as would be expected, present characters of great constancy. The results of this study are presented in the following key.

It will be noted at once that *Calamagrostis canadensis* (Michx.) Nutt. is not ascribed, as is usually done, to Beauvois as the author. While Beauvois used the name *C. canadensis* he failed to give any reference or description and according to the International Rules of Nomenclature (art. 37) his publication is not valid. After examination of a large number of specimens, mostly from eastern America and Alaska, it has become evident that the maintaining of *Cala-*